U. S. DEPARTMENT OF AGRICULTURE.

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Experiment Station Work, LXIII.

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STERILIZING TOBACCO PLANT BEDS.
CLOVER GROWING.
CURING CLOVER HAY.
THE VELVET BEAN.
DRAFT HORSES.
CARE OF MARES AND FOALS.

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PREPARED IN THE OFFICE OF EXPERIMENT STATIONS.
A. C. TRUE, Director.

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EXPERIMENT STATION WORK.

Edited by W. H. Beal and the Staff of the Experiment Station Record.

Experiment Station Work is a subseries of brief popular bulletins compiled from the published reports of the agricultural experiment stations and kindred institutions in this and other countries. The chief object of these publications is to disseminate throughout the country information regarding experiments at the different experiment stations, and thus to acquaint farmers in a general way with the progress of agricultural investigation on its practical side. The results herein reported should for the most part be regarded as tentative and suggestive rather than conclusive. Further experiments may modify them, and experience alone can show how far they will be useful in actual practice. The work of the stations must not be depended upon to produce "rules for farming." How to apply the results of experiments to his own conditions will ever remain the problem of the individual farmer.—A. C. True, Director, Office of Experiment Stations.

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ILLUSTRATIONS.

EXPERIMENT STATION WORK.[1]

STERILIZING TOBACCO-SEED BEDS.[2]

Following the successful practice of sterilization of soils for forcing greenhouse crops, the Connecticut State Experiment Station, in cooperation with this department, conducted experiments in sterilizing tobacco beds, the results of which have led several growers to adopt the practice, which has thus been abundantly tested and proved to be practicable and profitable. The practice consists either in steaming the soil sufficiently to kill all foreign seeds and micro-organisms in it to a depth of 2 inches or more, or in treating the beds with formalin for the same purpose.

Beds which have been properly sterilized by steam will need no weeding, as only an occasional weed will show itself before the seedling tobacco plants are pulled. This saving of labor alone pays the cost of sterilizing when the apparatus for it is at hand. The root rot will also be killed and the tobacco thus saved from its attacks. Whether "calico" is lessened by the treatment has not been determined, although our observation this year, to which we refer later, suggested that this might be the case.

It is a matter of common observation, both in greenhouses and in tobacco beds, that the plants in sterilized soil start quicker and grow faster than in untreated soil. This may be in part explained by the warming of the soil, partly by a possible solvent action of the steam or heated moisture on the plant food in the soil, but is no doubt in large part due to a change in the microbe life of the soil effected by the treatment, which may utterly destroy certain kinds of microbes, repress others, and yet leave conditions favorable for the rapid growth later of those species which make available the nitrogen of the soil or otherwise favor the growth of the tobacco plant.

The root rot and some other fungus troubles appear to be completely destroyed by steam sterilization and largely by the formalin treatment.

STEAM STERILIZING.

There are required a portable steam boiler—6 to 8 horsepower—which will maintain a pressure of from 75 to 100 pounds, and steam hose which will stand that pressure, with the necessary connections. The steaming apparatus found most convenient was devised by Mr. A. D. Shamel and is shown in figure 1.

It is a pan 6 by 10 feet square and 6 inches deep, made of 18-gage galvanized iron and having a handle bar at each end. It is reenforced with strap iron to make it more rigid and is fitted with a nipple for the hose connection. The one in use at East Hartford cost $40 and should last 10 years.

[1] A progress record of experimental inquiries, published without assumption of responsibility by the department for the correctness of the facts and conclusions reported by the stations.

[2] Compiled from Connecticut State Sta. Bul. 166; see also U. S. Dept. Agr., Bureau of Plant Industry Bul. 158, p. 35.

If a sterilizing pan can not be got readily, experience has shown that a tight wooden box of about the same measurement is equally effective, and being a poor conductor of heat probably needs less steam to do the same work.

The bed, having been fertilized, is raked smooth and made ready for sowing. The pan is inverted over one end of the bed and its edges pressed well into the soil. Steam is turned on and kept at a pressure of at least 70 pounds for 30 minutes. * * *

The pan is then moved on, and it is recommended to cover the steamed soil with burlap to hold the heat as long as may be.

Where the beds are many and long, much time can be saved by putting the boiler midway of the bed and using two sterilizers, one at each end of the bed.

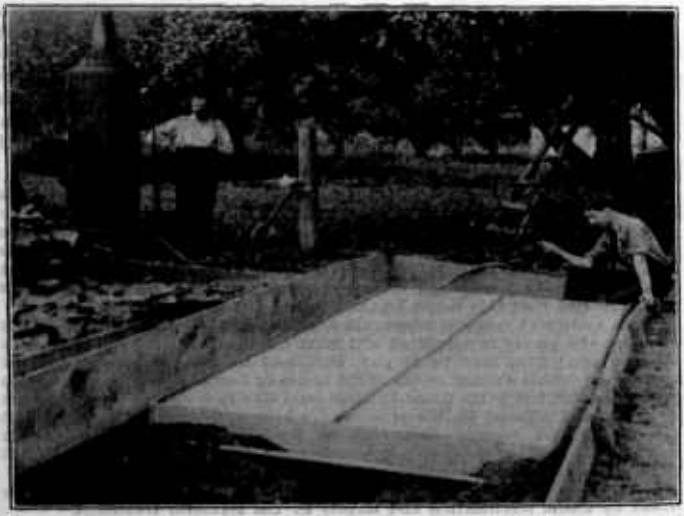

FIG. 1.—Steam sterilizer for tobacco-plant beds.

The steam is turned into the second when the first has been steamed for 30 minutes, and the pan remains there to hold the heat for 25 minutes and is then moved on. * * *

STERILIZATION WITH FORMALIN OR FORMALDEHYDE.

Steam sterilization is the more convenient where a boiler is near at hand and effective in killing weed seeds, but for small beds and places where the other apparatus can not be got, the formalin treatment can be substituted. It is best applied in the fall and when the soil is comparatively dry. The following method was successfully used by Dr. Clinton of this station in 1907[1]:

A solution of 1 part of formalin—40 per cent strength—in 100 parts of water; that is, a pint of good commercial formaldehyde, also called "formalin," in

[1] See also method proposed by A. D. Selby in Ohio Sta. Circ. 50.

12½ gallons of water, was gradually sprinkled over the bed at the rate of 1 gallon per square foot, taking care not to puddle the soil. The bed was then covered with burlap or sash to hold in the fumes.

Spring treatment leaves the bed wet and cold and it should not be sown for a week after treatment, lest the formalin still in the soil should kill the sprouting seed. Stirring the soil will facilitate the evaporation of the formalin and excessive moisture.

For further directions regarding the planting of the seed and the subsequent culture of the plants the reader is referred to previous Farmers' Bulletins of the department.[1]

CONDITIONS ESSENTIAL TO CLOVER GROWING.[2]

W. P. Brooks, of the Massachusetts Agricultural Experiment Station, gives the following concise summary of conditions essential to the most successful and profitable growth of clover as brought out by his own experience and observation:

Successful clover growing is impossible unless the soil conditions are right. These plants will thrive upon a considerable variety of soils as regards texture and composition, but for the best results a deep, mellow, and fairly retentive soil which is well drained is essential. Clovers will absolutely fail if there is any considerable proportion of free acid in the soil, or, in farmers' language, if the soil be "sour." If blue litmus paper in contact with moderately moist soil turns red as it absorbs the moisture, this is an indication that the soil is sour; but the farmer will be wise if, before incurring any considerable expense for the correction of acidity, he makes a careful test for himself. One of the best farmer's tests can be carried out as follows: Take two small plats of land in a field supposed to possess "sour" soil, and plow them both. Plats containing about 1 square rod each will be sufficient. They should, of course, be located in a representative portion of the field. After plowing, spread about 20 pounds of builders' lime or agricultural lime on one of the plats. Work this lime in deeply with the wheel harrow, then manure or fertilize both plats alike and heavily, and plant table beets. If the soil is sour, these beets will grow much better on the plat to which the lime has been applied than on the other, and it is safe to conclude that a heavy application of lime will be essential before clovers will flourish. If the experiment indicates that lime is essential, it will probably be needed at about the rate of 1 ton to the acre; the weight referred to to be taken before slacking. If air-slacked lime is used, 1½ tons to the acre will not be too much. The best season for applying lime is autumn or early spring. As a rule, it should be spread upon the plowed land and deeply worked in with the disk harrow.

The writer is aware that splendid clover is often grown where the land is heavily dressed with manure. He is not disposed to deny the possibility of producing fine crops of clover on manure alone. He would, nevertheless, urge that manure alone be not depended upon as a means of enriching clover land. The leading and most valuable element of plant food in manures is nitrogen. The application of this for clovers in any considerable amounts is unnecessary. If clovers are grown on manures, they will feed upon the nitrogen in the manure; they will not draw from the air for that element. Growing clover

[1] U. S. Dept. Agr., Farmers' Buls. 82, 343.

[2] Compiled from Massachusetts Sta. Bul. 134, p. 56.

upon manures, therefore, is not the best economy. Moreover, it is important to point out that the grasses with which clover is most generally grown are greatly invigorated by heavy dressings of manure. A strong, rank growth of the timothy and redtop will tend to crowd out the clover. Fine crops of hay may be produced, but it will not be clover hay, nor rich in clover. The writer would not be understood as urging that manure should never be used on land which is being prepared for clover, although he would strongly advise against top-dressing clover with manure. On soil which is naturally poor in nitrogen, manure may wisely be used in moderate amounts for crops preceding clover. Heavy dressings would be a mistake. It is far better to use the manure in only moderate or small amounts, and to use it in connection with materials which will supply lime, phosphates, and potash.

We should not forget, in considering the best means of growing clover, that the stock of nitrogen in the air from which it is capable of drawing is practically unlimited. The more of this nitrogen we can gather in the crop and in its roots and stubble, the better. In a certain sense, this trapped atmospheric nitrogen is so much clear gain. In considering this point, it must be remembered that the clover plant, like other plants, must take the different food elements in a certain balanced proportion. Though the nitrogen the clovers need is practically unlimited in amount, they can not make a heavy growth unless provided with a great abundance of the elements which they must take from the soil. It is clearly unwise to lessen our chances for gathering the valuable element nitrogen from the air through failure to supply the soil elements in adequate amounts. The rule, then, in preparing for clover or in top-dressing for clover, should be to supply the phosphates, potash salts, lime, and possibly magnesia in great abundance. With these present in abundance, and with a soil of such a character that it will furnish suitable conditions and supply the needed moisture at critical times, enormous crops of clover may be produced.

One of the most important discoveries of recent times is the now generally known fact that the presence of certain bacteria living in symbiotic relations with the clovers and other members of the clover family, and found in nodules on their roots, is essential in order that these plants may draw upon the air for nitrogen. The nodules which in the case of clovers indicate the presence of suitable bacteria are whitish, more or less elliptical bodies, of about the size of the head of a small pin. These grow singly or in small clusters, mainly on the smaller roots. They can be readily found by taking up clover plants grown under proper conditions, with care not to break off too many of the small roots. Bacteria, as is generally understood, are plants. They are very minute. The bacteria themselves are the veriest dust of the dust. As might be supposed, therefore, they appear to be very widely and freely disseminated, and probably through the air. The slightest currents of air must carry them. The dust from a freshly turned clover sod must contain countless millions of them. In certain quarters it has been urged that failures to produce good clover are frequently due to the absence of suitable bacteria, or to their presence in insufficient numbers. Certain experiments with sterilized soils * * * indicate to the writer that clover bacteria are everywhere; and it is not his belief that failures to produce satisfactory crops of clover in this State can often, if indeed they can ever, be attributed to the cause under consideration. The writer has never seen a case where, if a soil be brought into proper condition as to drainage and freedom from acidity, and well stocked with phosphates and potash, clovers have failed to grow; and he has never observed clover plants in any locality and failed to find abundance of nodules on their roots. It is, however, of course a possibility that there may be localities where it will

pay to inoculate the soil designed for clover with suitable bacteria. This inoculation may be carried out in either of two ways. First, soil from a locality where clover thrives and where the nodules are known to be abundant may be scattered over the field where the clover is to be sown, and immediately harrowed in. Five or six hundred pounds of such soil per acre will be sufficient. Second, a culture of the proper species of bacteria may be used in accordance with directions which will be furnished with it.

Full directions regarding the inoculation of soils for leguminous plants are given in a previous Farmers' Bulletin of this department.[1]

CURING CLOVER HAY.[2]

In view of the difficulty generally encountered in securing properly cured clover hay, it is believed that the following suggestions on this subject by W. P. Brooks, of the Massachusetts Experiment Station, will be of interest and value to many who are engaged in the growing of clover for hay.

Prof. Brooks points out that the first consideration is the proper degree of maturity of the clover, and states that clover is often allowed to stand too late to give best results when cured as hay.

If it be suffered to remain until a considerable proportion of the heads are brown and the seed ripe, there will be but little rowen, while there is much danger that the roots of the clover will die after the crop is cut. Relatively early cutting, then—before many of the heads are brown—is desirable, both because a better rowen crop will be secured and because the clover will persist in the mowing longer.

Good weather is essential for the satisfactory making of clover hay, as it is, indeed, for the satisfactory making of any hay; but it is far more important in the case of the clovers than for timothy, on account of the fact that the clovers need much more drying. The best hour in the day for cutting, as it appears to me, is late in the afternoon. Whatever the hour, it is essential to keep in mind the fact that in the curing of clover hay it should be handled but little after it begins to dry. It is generally well understood that too much handling as the crop dries results in the breaking off of the leaves and heads, which are the most valuable portion of the crop. Whatever the hour of cutting, then, the fact should be kept in mind that this crop should be tedded but little in curing. If cut late in the afternoon, the crop may be tedded once the following forenoon. If the weather is particularly fine, it will then be ready to rake and put into cocks late in the afternoon of the same day. If the clover is curing more slowly, it may be best to leave it in windrows over one night, and to turn these carefully with the fork the next forenoon, and to cock on the afternoon of the second day after cutting. The use of hay caps in curing clover hay should be more general. It is desirable to leave the clover in the cock for a number of days, sometimes as long as a week. The hay is coarse, and if exposed to rain it is badly damaged unless the cocks are protected by caps. When examination shows that the clover in the cock is apparently cured, it should be slightly opened and turned up from the bottom on the forenoon of

[1] U. S. Dept. Agr., Farmers' Bul. 315.

[2] Compiled from Massachusetts Sta. Bul. 134, p. 67.

a good day. It will then be ready to put in in the afternoon. Clover hay cured in this manner should hold substantially all its leaves and heads, and should cure of a bright-green color. Such clover is one of the most valuable forage crops, whether for cattle, sheep, or horses. Well-cured clover hay, popular opinion to the contrary notwithstanding, is a safe and valuable food for horses, which will need much less grain when fed such hay than when timothy hay is used.

THE VELVET BEAN.[1]

Few crops give satisfactory results for as many purposes as the velvet bean (figs. 2 and 3). Its first use was for the purpose of cov-

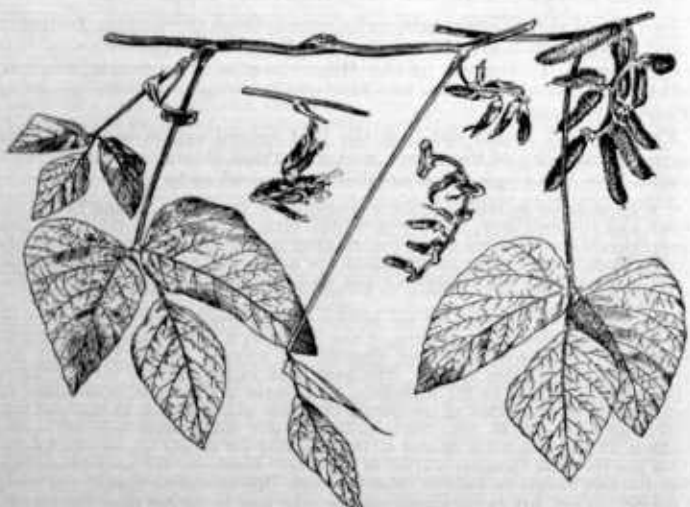

FIG. 2.—Velvet bean, showing leaves, flowers, and young pods.

ering trellises, screens, or unsightly places. Its quick rank growth makes it excellent as a cover crop and for ornamental purposes. This feature makes it objectionable in citrus groves because of the danger that the trees will be completely shaded, or that the vines will interfere with gathering the fruit. In open fields, however, it is not only an excellent cover crop but is very efficient in the eradication of troublesome weeds. Its use for human food is limited.

[1] Compiled from Alabama College Sta. Bul. 104; Florida Sta. Buls. 60 and 102; North Dakota Sta. Bul. 35; U. S. Dept. Agr., Farmers' Buls. 78, p. 12; 102, p. 41; 300, p. 9; Bur. Plant Indus. Buls. 141, p. 25, and 179; Div. Agrostology Circ. 14.

Like other legumes it is of great importance as a soil improver. The nodules which collect nitrogen from the air vary in size from a mere speck to the size of the pecan. The greater part of the nitrogen, however, is found in the vines, leaves, and seeds. An entire crop

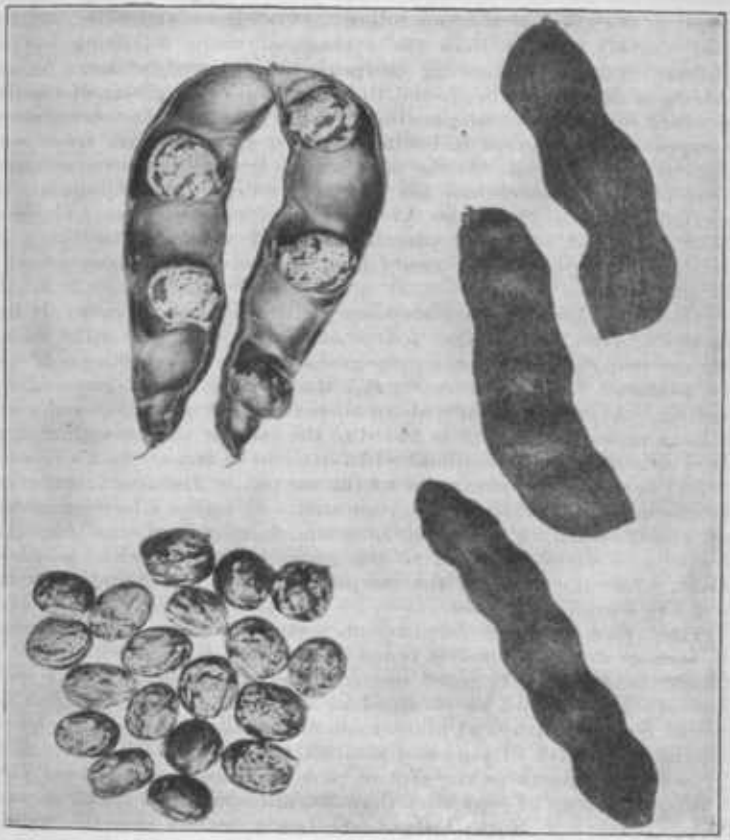

FIG. 3.—Velvet bean, showing mature pods and seeds.

plowed under as a fertilizer has been found to add to each acre ammonia equivalent to that applied in 1,900 pounds of cottonseed meal containing 7.5 per cent of ammonia. A ton of beans in the pod contains 54.8 pounds of nitrogen, 31.8 pounds of potash, and 13.8 pounds

of phosphoric acid, having a fertilizing value of $10 or $11. The hulls contain a much higher percentage of phosphoric acid and potash.

In Florida the average of an oat crop produced after velvet bean stubble, and one after the entire crop plowed under was four times as great as the average of crops following crab grass and millet stubble, and slightly greater than the average of crops following cowpea stubble and that following cowpea vines plowed under. At the Alabama Station it was found that the crop of sorghum was nearly doubled as the result of plowing under a crop of velvet beans or of cowpeas. The returns following the two green manure crops were approximately equal. At the same station both velvet beans and cowpeas produced more than four times as much green forage as did German millet. From the Alabama results the cowpea and velvet bean appeared to afford practically equal yields of hay on good land, but on poor, deep, sandy land the velvet bean may afford a larger yield.

The velvet bean is considered especially suited to Florida. It furnishes a better and cheaper source of protein than any other winter forage crop, but does not supply green pasture at any time. It may be pastured from December until the appearance of grass in the spring. As cattle eat only about 50 per cent of the leaves and vines, a large amount of humus is added to the soil for the succeeding crop. It is estimated that an animal will fatten on 1½ acres. In Florida the velvet bean has the advantage of the cowpea in freedom from attack by the nematode which causes root knot. It makes a heavier growth of vines, returning more ammonia and humus to the soil, and the leaves and vines go down to the ground together when killed by frost, while the vines of the cowpea remain upright and allow the wind to scatter the leaves.

These facts probably furnish sufficient explanation for the increase in acreage devoted to velvet beans in Florida—from 10,829 in 1901 to 22,939 in 1907–8. It must be remembered, however, that equally good results can not be obtained in all parts of the country. The velvet bean is a tropical plant requiring about eight months for its maximum growth of vine and production of seed. While it may be grown as far north as the central part of Missouri, it will not yield a profitable crop of seed more than 200 miles north of the Gulf coast. When planted in North Dakota, the beans made a growth of about 18 inches and were in bloom when harvested just before the frosts of early fall. The analysis of the air-dry substance of this crop indicated that the beans were much inferior to peas as nitrogen gatherers in that climate, as the plant contained but 2.57 per cent of nitrogen as compared with 3.6 per cent found in pea plants grown under the same conditions.

The time of planting velvet beans will depend upon the latitude, season, and the purpose for which the crop is grown. In north central Florida, planting for a hay crop may be done any time from May 20 to July 1, but if the crop is to be plowed under the following fall or winter, pastured through the winter, or harvested for seed, the planting should be done not earlier than April 1 nor later than May 1. Such early plantings, however, are likely to result in a tangled growth of coarse, woody vines difficult to harvest for hay and unpalatable to stock. The Florida Station finds that velvet beans planted during the latter half of April will produce three or four times as many beans as those planted after June 20.

Sound seed must be used to secure the largest yield. If the beans are planted in the pod, they may be soaked over night to soften the pods and hasten germination. This method of planting wastes seed, prevents planting by machinery, produces an uneven stand by reason of poor germination, and renders seed selection by means of the fanning mill impossible. Velvet beans may be improved in yield by seed selection. At the Florida Station selected seed produced 33.79 bushels of shelled beans per acre, while the yield from seed just as it came from the huller was 28.37 bushels. This increase in yield made a difference of about $10 per acre in gross income from the crop as a return for the rejection of the small, shriveled, and faulty beans at planting time.

As velvet beans can not be cultivated after the vines have reached any considerable length, preparation of the seed bed should be deep and thorough. In Florida the ground should be plowed to a depth of 6 inches in December or January and harrowed the same day. The use of the harrow should be resorted to at intervals of 10 days throughout the winter until the beans have been planted. The method of plowing just enough to cover the beans and leaving the middles unplowed usually results in the production of about one-half a crop.

If planted alone velvet beans should be 10 to 15 inches apart in the drill, in rows 4 feet apart, or at the rate of about a peck of seed per acre. It is better, however, to plant in rows 6 or 8 feet apart, alternating with rows of corn or sorghum to help support the vines. This method produced a yield of 20.3 bushels of shelled beans per acre at the Florida Station, while the former method produced a yield of 22.5 bushels per acre. The yield of corn "was perhaps 5 to 10 bushels." At the Alabama Station a yield of 7,300 pounds of hay per acre was obtained by planting in drills 2 feet apart, while the best yield obtained by broadcasting was 5,360 pounds. The same method produced the best yield of cowpea hay.

The Florida experiments indicate that the velvet bean is a crop that does not respond economically to the application of any fer-

tilizer on that soil. An increased yield was sometimes obtained, but cost more than it was worth. As with other legumes, however, inoculation may be necessary and may be accomplished by securing from an old cowpea field a quantity of soil about equal in amount to the seed to be planted. Just before planting the seed may be moistened and mixed with the soil. In this way the field is supplied with the micro-organisms necessary for the normal development of the nitrogen-gathering nodules.

When planted in rows, velvet beans should be cultivated until their growth renders further tillage impossible. After this time the vines themselves will smother out all weeds and grass and the roots will obtain abundant plant food if the seed bed has been properly prepared.

The time of harvesting will depend entirely upon the purpose for which the crop has been grown. If used for hay, the crop should be cut just when the young buds are well formed, allowed to wilt about 48 hours, and cured in the shock for several days. To avoid loss through the dropping of leaves, the vines must not become too dry before being placed in the shock. The danger of heating is somewhat less than in case of pea vines, as the beans do not pack together so closely, but the shock should not be too large. If grown as a green manure in Florida, the crop should be plowed under in December in order that the leaves and vines may be well rotted before spring planting begins. If grown for seed, harvesting should not begin until the vines have been killed by frost, but should be completed as early in December or January as possible. If grown as a forage crop, the beans may be left in the field throughout the winter with little loss from decay.

The velvet bean is a highly nitrogenous feed and should not be fed alone, as such feeding has been reported as causing abortion among cattle and hogs and blind staggers in horses. The hay when fed exclusively to horses is likely to cause kidney trouble, but this danger may be overcome by mixture with an equal amount of crabgrass hay. It is also stated that the fat of hogs fed too exclusively on velvet beans is dark in color and offensive in taste and smell.

The velvet bean has but one insect enemy causing serious injury. This is the caterpillar of the moth *Anticarsia gemmatilis*. The crop is not usually attacked until the beans begin to bloom, when the larvæ first eat small holes in the leaves, then as their number and size increase they devour the leaves entirely, leaving nothing but the bare stems of the plants. Blackbirds, ricebirds, and the "green sparrow" render effective service in holding this insect in check, especially the former, when they appear in large flocks. The larger birds are so clumsy that they allow many insects to escape, but the "green sparrow" gets under the vine and picks off numerous caterpillars. The

most effective artificial remedy yet discovered is the application of from 1 to 3 pounds of Paris green per acre. The Paris green may be mixed with air-slaked lime in the proportion of 1:3. The mixture may be placed in a bran sack or other loosely woven sack and such sack attached to the ends of a board 6 feet long and balanced on a mule's back. If a boy rides the mule up and down between the rows of beans, the continuous jolting will sprinkle enough Paris green on the foliage to poison the caterpillars. If necessary the boy may strike the board gently with his hand to increase the rate of application. There will be no danger of loss of stock pasturing on velvet beans after such treatment. The amount of Paris green applied is small, and the rains soon wash it off the foliage.[1]

QUALITY AND CONFORMATION OF DRAFT HORSES.[2]

The typical, ideal draft horse, according to A. S. Alexander, of the Wisconsin Experiment Station, stands over 16 hands (5 feet 4

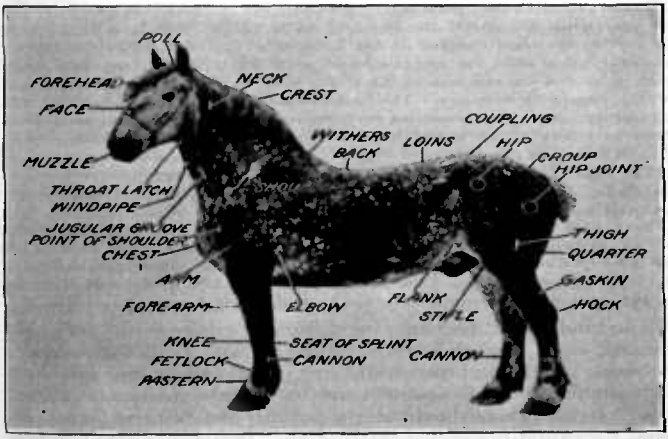

FIG. 4.—A high-grade work horse of fine quality and good conformation, illustrating the "points" of a draft horse.

inches) and under 18 hands high, and weighs 1,600 pounds or more in ordinary flesh. (Fig. 4.)

[1] For further information on this caterpillar see U. S. Dept. Agr., Bur. Ent. Bul. 54, p. 77.

[2] Compiled from Wisconsin Sta. Circ. Inform. 17. For description of market classes and grades of horses see U. S. Dept. Agr., Farmers' Bul. 334, p. 22.

The form should be broad, deep, massive, evenly proportioned, and symmetrical, the entire make-up suggesting great strength and weight. The body should be massive, blocky, and compact, and squarely set on short, broad, clean, sturdy legs showing fine skin, large joints, and prominent tendons.

Good quality is shown by fine, bright, silky hair; soft, pliable skin; clean, well-defined tendons; smooth, well-developed muscles; strong, smooth bones. It usually is associated with style, spirit, and intelligence indicative of "breeding." * * *

The draft horse should walk spryly, with regular, straight steps and elastic tread. The action when trotting should be free, springy, and straight. * * *

A draft horse does most of his hard work at the walking gait. It is therefore important that he should be able to walk fast without tiring. He should be able to walk 4 miles an hour with a load. To do this the action must be perfectly regular, straight, and level. Joints must be quickly and fully flexed; feet must be advanced and set down without deviation from a straight line. Soles of the feet should turn up and show the shoes plainly as the horse moves away from the observer, at both walk and trot. The feet should be lifted quickly and evenly, and be set down squarely and firmly.

There should be no "paddling," "dishing," or "winging" in or out, cutting or interfering, nor should the fore legs swing out or "roll," or the hind legs be carried too close together or too far apart. In judging of the action the observer must note the movements of each leg and foot, the handling of each joint and the carriage of the entire body, as the horse walks and trots. Watch closely for lameness. The hocks should be carried well together when in motion. Rolling or waddling in front is due to too great width of chest. Knee and hock action should both be free and comparatively high. Perfection of action at the walk is of highest importance in the draft horse.

The draft horse should show a vigorous, lively, energetic disposition, yet be docile, tractable, and intelligent. He should be neither sluggish, nor irritable, nor excessively nervous.

Noticeable vices, as cribbing, wind sucking, weaving, tail switching, shying, biting, kicking, head shaking, etc., are undesirable and a horse showing one or more of these habits should be cut sharply. Sluggishness associated with fat should be avoided, as it induces disease. Stupidity, clumsiness, meanness, or excessive nervousness are objectionable and should discount the animal.

The head should be large, proportionate in size to the body, well formed, clean, and free from coarseness and irregularities. The forehead should be broad, full, and not dished or too prominent. The profile of the face should not be too straight or of "Roman-nose" form. There should be good width and fullness between the eyes, indicating power and intelligence. The eyes should be bright, clear, mild, full, sound, and of the same color. The lids should be smooth, well arched, and free from angularities and wrinkles. The ears should be of medium size, well placed, alert, normally active, and free from coarseness. The nostrils should be large and flexible; the lips thin, even, and firm, and all of the parts neat and clean cut. The skin and hair of the muzzle should be of good quality. There should be a wide space between the lower jaws free from

meatiness, abscesses, or tumors. The neck should be of a size proportionate to the rest of the body, well arched, evenly muscled, with large windpipe and smooth insertion into the shoulder. It should not curve downward (ewe neck) or be broken in crest.

It should fit neatly into the head and be free from thickness, coarseness, and enlargements at the throat latch. The neck should merge evenly and smoothly into the withers and shoulders and be free from sores at the seat of the collar. The mane should be thick, lie properly and of good quality. Largeness of the windpipe indicates good breathing powers. The jugular vein should show no scars of bleeding and the glands about the throat should be clean and of normal size.

The shoulder should be moderately sloping, smooth, and extending well back.

A majority of poorly formed draft horses have shoulders which are too steep. Occasionally the shoulders are too sloping. Either extreme in a draft horse is objectionable. Trouble with collars comes from these causes when the horse is doing heavy pulling. The correctly laid shoulder should form a smooth, comfortable bed for the collar. Straight or upright shoulders detract from easy, free action of the forelegs and generally are found associated with upright pasterns. Theshoulders should be smoothly and deeply covered with muscles and be free from coarseness, roughness, sores, and tumors. The withers should be well covered and moderately high.

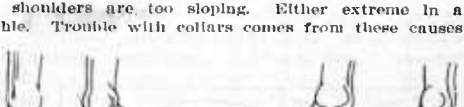

FIG. 5.—Correct and incorrect types of pasterns and feet: *a*, Pastern too straight and upright; *b*, pastern too sloping; *c*, correct type of forefoot; *d*, correct type of hind foot.

The arm, which extends from the point of the shoulder to the elbow, should be short, heavily muscled, and well thrown back. The forearm, extending from the elbow to the knee, should be long, flat, wide, heavily muscled, and free from coarseness. The knees should be straight, wide, deep, strongly formed, and smooth. The cannons, extending from the knees to the fetlocks, and composed chiefly of bones and tendons, should be short, strong, clean, and wide, with prominent and smooth tendons. The fetlocks should be wide, straight, strong, and free from puffs, callouses, or interfering sores. The pasterns, extending from the fetlocks to the hoof heads, should be moderately sloping, strong, and clean. (Fig. 5.)

The tendency in the average draft horse is toward short, upright pasterns and stubby gait. This is highly objectionable as are also very long, weak pasterns, which bring the back of the fetlocks too close to the ground. The latter cause strain upon the tendons when drawing heavy loads. The short upright pasterns are even more objectionable since they prevent springy, elastic action of the feet and allow concussion to jar the bony columns of the legs. The irri-

tation and inflammation induced by continued jarring often results in sidebones, ringbones, corns, and kindred diseases. The bone of the pastern should have a slope of about 45° and the front of the foot 50°. Horses having upright pasterns and consequent stubby action wear out quickly when used upon paved streets.

The hoofs should be ample in size, sound, smooth, and symmetrical in shape.

The hoof is a continuation of the skin of the parts above. The color of the skin decides the color of the hoof. Dark-colored hoofs are preferred. Color counts for little, however, if the hoofs are of poor shape and texture. The horn should be smooth, waxy looking and free from cracks or ridges and the coronets (hoof heads) should be open, prominent and wide at the heels. The sole should be slightly cupped (concave), not flat, or bulging (convex); the frog large, elastic, healthy, and without a deep cleft; the bars prominent.

The chest, inclosing the heart and lungs, should be roomy in every respect. "An ample, wide, deep chest denotes vigor, power, strong constitution, and easy keeping qualities." The ribs form the "barrel" and should be deep, well sprung, and carried low at the flanks and close to the hips. The back, extending from the rear of the withers to the last rib, should be broad, straight, and muscular. In general appearance it should denote great strength and compactness. The loins should be short, wide, deep, and strong. The underline should run back full and low from the floor (sternum) of the chest. "If the underline slopes sharply upward to the stifle the abdomen has a cut-up appearance. This indicates lack of roominess and denotes poor keeping qualities."

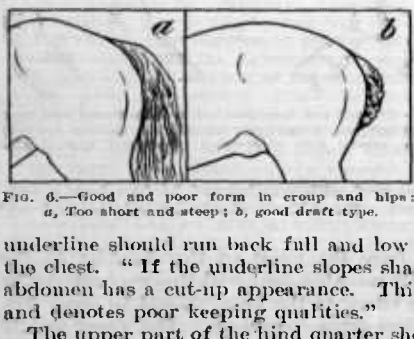

FIG. 6.—Good and poor form in croup and hips: *a*, Too short and steep; *b*, good draft type.

The upper part of the hind quarter should show great development of wide, thick, smooth muscle without angularities and coarseness. The croup, the part of the hind quarter from top of the hip to the insertion of the tail, should show comparative levelness, ample muscle, and great strength. (Fig. 6.)

The most notable deficiency of this part in draft horses is excessive droop or steepness and shortness, with weakness of muscle. Such conformation tends to slouchiness in gait and often is associated with "sickle" hocks. The draft croup should be smooth, of fair length, and neither too steep nor perfectly level.

The thighs from the hips down to the stifles should be strong, muscular, wide, and long.

Slim, light, narrow, poorly muscled thighs denote lack of draft power. It is important that the thighs and all other parts of the hind quarters should be richly supplied with muscles.

Looking from the rear the plump muscles of the inner sides of the thighs form the quarters and should be full, thick, and carried well down to the second thighs (gaskins).

The stifle joints should be strong, thick with muscle, clean-cut in front, and free from dropsical swellings.

Like the elbows, they should be so set as to allow of straight, free action, and therefore neither appreciably turned toward or away from the body.

The gaskins, or lower thighs, correspond to the forearms, and should have the same qualities; the muscles should be large, prominent in front of the bone, and carried well downward. The hocks are most important joints because the great strain of starting and hauling a load falls upon them, and they will soon break down if not very strong and perfectly sound. The joints should be large, clean, sharply defined, wide, deep, and well set.

Poor hocks are a common fault in draft horses. It is important to improve this deficiency. To that end breeding animals should have good hocks, and for work horses this also is imperative. The hock (not "hind knee") is commonly the seat of some one of such diseases as bone and hog (not "blood") spavin, thoroughpin, and curb. These should be avoided. The joint should look and feel firm, hard, and with each bone well defined, free from meatiness and of great size. The point of the hock should be prominent, clean, and sharp, and the tendons under it straight, distinct, but free from bulging.

What has been said regarding cannons, fetlocks, pasterns, and feet of the foreleg applies with equal truth to the corresponding parts of the hind extremity.

The cannons of the hind leg should have the same wide, flat appearance desirable in those of the foreleg. As the hind feet strike the ground a slanting blow, while concussion on the forefeet is direct, absolute correctness in form and perfect soundness is somewhat more important in the forefeet than in the hind feet. The hind pasterns may be slightly more upright than those of the foreleg. The hoofs of the hind limbs are steeper and narrower than those of the forelegs. The hind fetlocks are most likely to be blemished by puffs and interfering sores.

CARE OF BROOD MARES AND NEWBORN FOALS.[1]

The loss of foals before weaning time has been variously estimated at from 10 to 25 per cent. According to Dr. A. S. Alexander, of the Wisconsin Experiment Station, the greater part of this loss can be avoided if proper attention is given to the pregnant mare and to the foal during the first few weeks of its existence.

MANAGEMENT OF THE PREGNANT MARES.

Many brood mares are overworked and others are kept too closely confined in stables. Both stallions and mares should be moderately

[1] Compiled from Wisconsin Sta. Circ. Inform. 13.

worked and kept in the open as much as possible. If kept in a stable, the latter should be well ventilated, and much of the time the mare should be in an open shed. Good pasture grass is the best feed. Corn should not be fed except in small quantities.

The mare in foal should be worked lightly or abundantly exercised every day. Exercise is absolutely necessary. She should occupy a roomy box stall. Here she will take some additional exercise and will not be afraid to lie down. She will be less likely to become "cast" and escape having "stocked" legs and dropsical swellings of the udder and abdomen. The bedding should be kept clean and dry.

Feed the mare sound, whole oats, bran, and mixed or timothy hay. Avoid moldy hay or silage, damaged grain, woody, weathered fodder, dusty or rusty straw, or hay containing ergot. Keep pregnant mares out of cornstalk fields. Provide them with plenty of pure, clean water. In working mares avoid jerking, severe pulling, wading through deep mud, manure piles, or snowdrifts. Let the work be light, easy, and steady. Keep the bowels active by feeding bran and a little linseed meal, carrots, or some sweet silage.

The mare goes 48 weeks, or about 340 days with foal. As foaling time approaches decrease the grain ration and increase laxative foods to keep the bowels acting freely. Constipation is dangerous. When wax forms on the teats, about three days before foaling, stop working the mare and place her in a prepared box stall where she can be watched until the foal is born.

After foaling leave the mare alone for a time, if she is lying down. If she does not expel her afterbirth promptly when she rises from resting, inject into her womb one-half gallon of lukewarm 1 per cent solution of coal-tar disinfectant, or other mild antiseptic. If the afterbirth then does not come away within an hour or two, it should be removed by hand. An expert should be employed for this operation and when it has been performed the womb should again be flushed out with an antiseptic solution. Half an hour after the birth of the foal, or about that time, offer the mare a pailful of lukewarm water and again at intervals of two hours. Mares are thirsty at this time and should be abundantly supplied with water. An hour after foaling the mare may eat a mash of steamed oats and bran, if she has been accustomed to such feed; otherwise give her a small feed of her ordinary grain ration. In a few days, if the weather is fine, the mare and foal may take some outdoor exercise, and in two weeks, or thereabouts, she should have recovered from foaling and be taking her usual feed, grazing grass and getting ready to resume light work in harness.

Two 14 by 14 foot box stalls should be kept ready for the use of mares on every farm where foals are raised. No mare should be allowed to foal in an ordinary stall or unprepared box stall. Navel and joint diseases will not be likely to attack foals born in clean places. An absolutely clean foaling place is necessary and should be prepared as follows:

Remove and burn all loose litter and manure. Cleanse and scrape the floor; then saturate it with a hot 1 to 50 solution of coal-tar disinfectant or a solution of 4 ounces of sulphate of copper (bluestone) to 1 gallon of hot water. Scrub and cleanse the walls with a similar solution of coal-tar disinfectant or a 1 to 1,000 solution of corrosive sublimate. Cleanse the ceiling in the same way; then apply to walls and ceiling fresh-made lime whitewash, to each gallon of which has been added one-third of a pound of chlorid of lime. Cover the floor with fresh, dry planing-mill shavings in preference to any other bedding material. Remove manure as soon as it is dropped.

CARE OF THE NEWBORN FOAL.

When the foal is born and has been cared for and the afterbirth of the mare has come away, remove the mare and foal to the second box stall, prepared as was the first. Then clean out, disinfect, and whitewash the stall just used and put in fresh, clean, dry shavings, in readiness for the reception of the next mare. The mare must always occupy a clean, specially prepared box stall, and it should be perfectly ventilated and as sunny as possible.

Where but one box stall is available clean it out, burn the afterbirth and soiled bedding, use a disinfecting solution freely on the floor, and put in plenty of fresh, dry, clean shavings as soon as possible after the birth of the foal. If the mare foals on grass, treat the foal as if it had been born in the stable. Navel infection is less liable to occur on grass, but this is possible, and preventive treatment therefore is necessary, no matter where the foal is dropped.

Attend to the navel cord (umbilicus) as soon as the nose of the foal has been cleared of afterbirth. If possible, avoid tying the navel cord. It is best for it to break off naturally. If it fails to break and the mare is lying down, make her get up, and the cord may then break.

If found necessary to tie the cord, use a clean disinfected string. A dirty string may cause infection. Soak the string in a 5 per cent solution of lysol or carbolic acid or a 1 to 500 solution of corrosive sublimate (bichlorid of mercury). Tie the cord 1 inch or a little more from the belly; then sever the cord with a clean knife. An emasculator or ecasenr (castrating instruments) may be used to sever the cord in place of tying it and then cutting through below the knot.

Saturate the stump of the navel cord immediately, whether tied or not, with the following disinfectnnt: Powdered corrosive sublimate, 2 drams; boiling water, 1 pint. When it has cooled, color the solntion with 2 drams of tinctnre of iron, label the bottle "poison," and keep it ont of the way of children. Repeat the application twice a day until the cord shrivels up, drops off, and no raw spot remains. To keep the solution from blistering the foal's belly, smear carbolized vaseline or unsalted lard around the navel before makiug the first application.

A good way to use the solution is to put some of it in a shallow, wide-necked bottle, then hold the bottle against the foal's belly with the navel stump immersed so that it will be completely covered by the fluid. If the navel cord has been tied, remove the string as soon as possible, squeeze ont the blood clot, and instantly soak the navel stump with the corrosive sublimate solution. Use the solution twice a day until the navel is perfectly healed. Remove sloughing portions of the cord each morning, so far as possible, to allow the solution to wet raw parts of the cord.

A strong foal will be on its feet and trying to nurse in less than an hour from birth. Such a foal needs no help, bnt a weak one will have to be held up to suck until strong enough to do so without help. Wash the udder of the mare with a lukewarm 2 per cent solution of coal-tar disinfectant and then rinse off with warm water before the foal is allowed to suck for the first time. The external organs (genitals), tail, and hind parts of the mare should be washed with a similar solution once a day for the first week or so after the birth of the foal.

Keeping the udder free from infective matter in this way tends to prevent the foal from scouring, for that condition of the bowels often is due to germ infection of the intestinal tract by way of the mouth. Disinfection of the navel cord

also tends to prevent scouring. At birth the intestine of the foal contains a sticky mass of fecal matter (meconium). This should come away promptly and usually this is accomplished by the first milk (colostrum), which possesses purgative properties. To assist nature, either insert a small tallow dip candle (made for this purpose) in the foal's rectum, or within an hour from birth give an injection of either warm water, warm slippery elm bark tea, thinseed tea, sweet oil, or a mixture of equal parts of cream, molasses, and warm water, and repeat in 12 hours if required. Harm may be done by injecting a large quantity of strong, soapy warm water with an ordinary "horse syringe." A fountain syringe is to be preferred and small hard-rubber nozzle or a small clean rubber hose and funnel. Smear vaseline or lard on the nozzle and in rectum before giving the injection. If the bowels do not move within 24 hours from birth and the foal seems sick, shake up two to four tablespoonfuls of pure castor oil in milk or a mixture of equal quantities of castor oil and sweet oil, according to size of foal, and give as one dose. Then continue the injections at intervals of six hours.

In case the mare dies or has no milk the foal may be raised on cow's milk, if the attendant conducts the work patiently and intelligently. Choose the milk of a cow that has recently calved, preferably one which gives milk low in butterfat; for mare's milk, while rich in sugar, is poor in fat. Sweeten the milk with molasses or sugar and dilute with warm water. Give a little of this prepared milk at short intervals from a scalded nursing bottle and large rubber nipple. Be careful to keep the bottle and nipple scrupulously clean. Add an ounce of limewater to each pint of the prepared milk and allow half a cupful once an hour at first.

As the foal grows, gradually increase the amount of milk fed and lengthen the intervals between meals. In a few days food may be given six times a day, and later four times daily. The foal will soon learn to drink from a pail if allowed to suck the attendant's fingers at first.

Until the bowels move freely give rectal injections night and morning. If the foal scours at any time, give two to four tablespoonfuls of a mixture of sweet oil and pure castor oil shaken up in milk and stop feeding milk for two or three meals, allowing sweetened warm water and limewater instead. Let the foal lick oatmeal as soon as it will eat and gradually increase the amount and add wheat bran. In five or six weeks some sweet skim milk may be given and the amount gradually increased daily until, in three months or so, it may be given freely three times a day in place of new milk. The foal at this age also will be eating freely of grass, grain, and bran.

At all times supply pure cold drinking water. Let the foal run out in a lot or grass paddock for exercise. Accustom it to be handled daily. Feed small quantities of nutritious food often, keeping all food vessels clean, and the foal should thrive and develop well.

NAVEL AND JOINT DISEASE IN THE NEWBORN FOAL.

Seventy-five per cent of the cases of this disease affect foals during the first three weeks of life. Fat, flabby foals, with extra large navel cords, often the get of overfed, pampered, underexercised stallions, or from mares in like condition—are especially prone to the disease and are most likely to succumb. Foals that have small navel cords and are lively at birth, soon on their feet and nursing, are much less liable to attack.

Dr. Alexander describes the symptoms of navel and joint disease as follows:

A few days after birth the foal is found to be weak, lame, feverish, and with impaired appetite. One joint or another is swollen, hot, and painful. Usually the attack affects the fetlock, hock, stifle, hip, knee, elbow, or shoulder. Sometimes abscesses form at the poll, about the ribs, or along the spinal column. The swellings rapidly increase in size and several joints are affected at one time. There is swelling of the navel, and pus oozes from one or more openings. Pus forms in quantities in the affected joints. Diarrhea usually comes on, or may be alternated with constipation. Soon the foal is too weak to stand, loses appetite entirely, and dies in a few days, or in two or three weeks, in lingering cases. Often urine escapes from the navel, or the foal passes bloody urine; but the latter symptoms may, for a time at least, be present without noticeable symptoms of pus infection.

The navel cord (umbilicus) connects the foal's body with the afterbirth (placental membranes) of the mare. * * *

When the navel cord breaks at birth its blood vessels and tube promptly close, if all goes well. If pus-forming germs from filthy or soiled bedding, floor, or ground, get onto the raw navel cord, however, they cause infection, inflammation, and collections of pus at the point involved, and thence germs are carried into the system and form colonies (secondary abscesses) elsewhere in the body, and notably in the joints of the extremities.

In cases of generalized infection (pyemia) abscesses may be found in the liver, kidneys, lungs, brain, muscles, and subcutaneous connective tissue. If the urachus fails to close, urine dribbles or streams from the navel opening and, in that event, abscesses of the joints eventually appear, the infection having become general. The latter condition is termed "pervious" or "persistent" urachus. A majority of infected foals die. Recovery is seldom perfect. The colts fail to thrive or develop perfectly, and are apt to have chronic affections of the joints. Treatment of the disease can only be properly conducted by the trained veterinarian, and he may employ a special (antistreptococcic) serum with some degree of success, both as a preventive and curative agent.

When working the mare the foal should be left in the stall. He will fret at first, but gradually gets accustomed to being alone. For the first few days the mare should be worked only half a day. She will be soft and worry greatly, probably heating herself up quite badly, in which case it is a good plan to milk her almost dry on coming in at noon and then put her in a stall to eat a little hay until she cools off. After this she may be watered, turned in the stall with the foal, and fed her grain. Beginning with a half day in this fashion she may be gradually toughened back into doing her full share of the regular team work. The foal should never be allowed to suck milk from a worn mare, as it sets up indigestion and starts scours. A bucket of water should be kept in the stall so the foal may take a drink whenever he wants it.

A foal will begin to nibble at grain when he is about a month old, sometimes earlier. His first food should be oatmeal, allowing him such small quantities of this as he will eat. At six weeks of age a

little bran may be added, to be followed later with grain. Grass should be supplied as soon as the foal wants it. When feeding bran or grain the supply should be renewed often so as to keep it fresh and sweet and any sudden changes in feeds must be avoided. If foals are thus cared for during the summer the weaning process is an easy one. When weaning the foal he should be kept away from his dam for good. Weanlings should have warm quarters during the first winter, and may be fed good oats and bran—one-fifth bran by weight—and choice hay free from dust and mold, the feed to be given often and a little at a time.

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